

REMARKS

Status of the Claims:

Claims 1 – 28 and 31 – 34 are currently pending.

Claims 1 – 28 and 31 – 34 are currently rejected.

Claims 7, 29 and 30 are cancelled.

Claims 1 – 3 and 10 are currently amended.

Amendments to the Claims:

No new matter has been introduced by way of the claim amendments.

Claim 1 is presently amended in step a)i) to incorporate the limitations of previous claim 7. Claim 1 is presently amended in step a)ii) to recite that the nucleation sites are operable for initiating a polymerization reaction after deprotonation to form initiator sites. Support for this amendment may be found in at least paragraph [0028] and Figure 3. Claim 1 is also amended in steps c) and e) to clarify that the polymerizable species is on the carbon nanotubes. Support for this amendment may be found in at least Figures 1 – 3. Claim 1 is also amended in step e) to recite that a polymer comprising the polymer-carbon nanotube material is covalently bound to the carbon nanotubes. Support for this amendment may be found in at least Figures 1 – 3.

Claim 2 is presently amended in step a) to incorporate the limitations of previous claim 7. Claim 2 is also amended in step c) to clarify that the aryl-lithium species comprises a polymerizable species on the carbon nanotubes. Support for this amendment may be found in at least Figure 1. Claim 2 is also amended in step c) to clarify that the polymerizable species comprises aryl-lithium covalent bonds. Support for this amendment may be found in at least Figure 1. Claim 2 is also amended in step e) to recite that a polymer comprising the polymer-carbon nanotube material is covalently bound to the carbon nanotubes. Support for this amendment may be found in at least Figure 1. Claim 2 is also amended in step e) for antecedent purposes.

Claim 3 is presently amended in step a) to incorporate the limitations of previous claim 7. Claim 3 is also amended in step c) to clarify that the aryl-metal species comprises a polymerizable species on the carbon nanotubes. Support for this amendment may be found in at least Figure 2. Claim 3 is also amended in step c) to clarify that the polymerizable species comprises aryl-metal covalent bonds. Support for this amendment may be found in at least Figure 2. Claim 3 is also amended in step e) to recite that a polymer comprising the polymer-carbon nanotube material is covalently bound to the carbon nanotubes. Support for this amendment may be found in at least Figure 2. Claim 3 is also amended in step e) for antecedent purposes.

Claim 10 is presently amended in step a) to recite that the nucleation sites are operable for initiating a polymerization reaction after deprotonation of the nucleation sites to form initiator groups. Support for this amendment may be found in at least paragraph [0028] and Figure 3. Step c) of claim 10 is also amended for consistency with step a), with support found in at least the same locations. Claim 10 is also amended in step e) to recite that a polymer comprising the polymer-carbon nanotube material is covalently bound to the carbon nanotubes. Support for this amendment may be found in at least Figure 3.

I. Claim Rejections Under 35 U.S.C. § 103

Claims 1 – 28 and 31 – 34 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over WO 02/060812 (hereinafter, *Tour*) in view of United States Patent 3,554,992 (hereinafter, *Lamb*). Office Action page 2, item 4. Applicants respectfully traverse the rejection of these claims in view of the arguments and amendments presented herein.

I.I Standard of Review

The standard of review for establishing obviousness is set forth as follows: "To establish *prima facie* obviousness of a claimed invention, all features must be taught or suggested by the prior art." *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974). Furthermore, "[r]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the

legal conclusion of obviousness". *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1741 (2007) citing with approval *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006). In addition, in issuing rejections under 35 U.S.C. § 103(a), the Examiner must consider an invention and the prior art as a whole in accordance with the requisite *Graham* factual inquiries. MPEP § 2141; *Ruiz v. A.B. Chance Co.* 69 U.S.P.Q.2d 1686, 1690 (Fed. Cir. 2004).

I.2 Examiner's Grounds for Rejection

With regard to claims 1, 2, 3 and 10, the Examiner alleges that *Tour* teaches SWNTs functionalized with an aryl chlorine-containing functionality. Office Action page 5. The Examiner also alleges that *Tour* teaches that halogenated SWNTs can participate in reactions with alkyl-lithium reagents via a Grignard reaction mechanism, as allegedly taught in *Tour* on page 2, lines 13 – 18. The Examiner also alleges that *Tour* teaches that functionalized SWNTs can undergo polymerization, including anionic polymerization, as allegedly taught on page 31 and claims 125 – 129 of *Tour*.

Particularly regarding claim 10, the Examiner alleges that the feature 'operable for anionic or ring opening polymerization' recited in claim 10 is inherently possessed in *Tour*. Office Action page 5. Furthermore, with regard to claims 33 and 34, the Examiner alleges that these claims recite intended uses. Office Action page 6.

The Examiner acknowledges that *Tour* does not teach the specific mechanism for preparing a polymer. Office Action page 6. However, the Examiner alleges that *Lamb* teaches using a Grignard reaction for initiating a polymerization process. The Examiner alleges that *Lamb* teaches specific types of monomers and various hydrocarbon and ethereal solvents for the polymerization process, including a suggestion of THF. Regarding claims 25 and 26, the Examiner alleges that *Lamb* teaches precipitating the polymers with methanol, such that a terminating agent is taught. Regarding claims 27 and 28, the Examiner alleges that the concentration and temperature variation constitute routine optimization.

In view of the foregoing, the Examiner alleges that one of ordinary skill in the art would have been motivated by the expectation of success of preparing a polymer with a Grignard

reagent to incorporate the specifics taught by *Lamb* into the teachings of *Tour* to obtain the claimed invention. Office Action page 7.

Regarding the 'deprotonating agent' of claims 14 and 15, the Examiner again alleges that *Tour* teaches that halogenated SWNTs can participate in reactions with an alkyl-lithium reagent via a Grignard reaction mechanism, as allegedly taught on *Tour* page 2, lines 13 – 18. Office Action page 7. The Examiner further alleges that *Tour* teaches that functionalized SWNTs can undergo various polymerizations, including anionic polymerization.

I.3 Applicants' Response to Examiner's Grounds for Rejection

Applicants respectfully traverse the Examiner's grounds for rejection as set forth hereinafter. Further discussion of why each independent and dependent claim are not obvious follows thereafter.

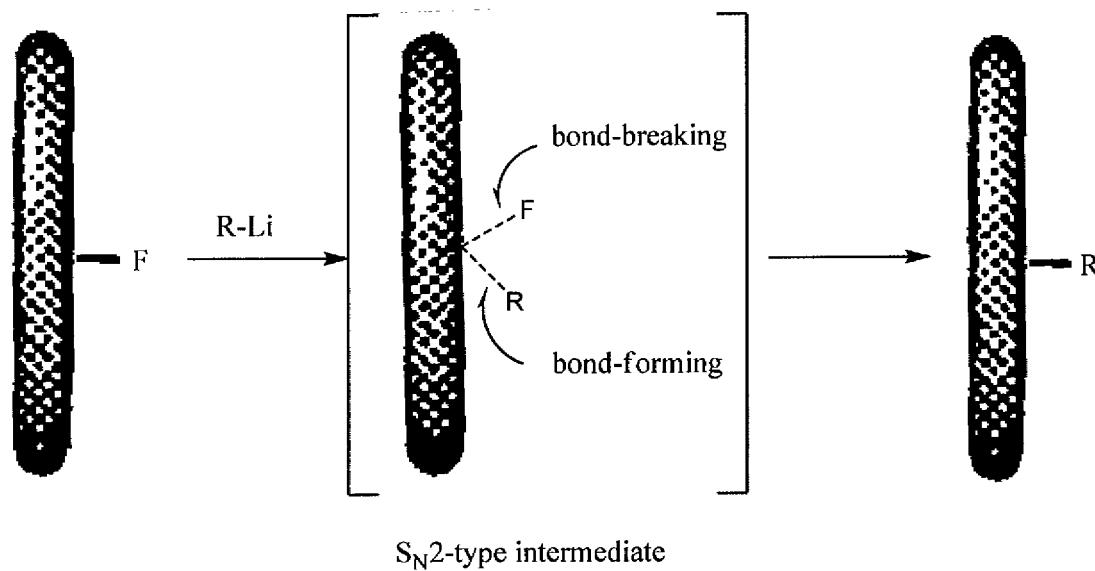
I.3.1 Tour Does Not Teach or Suggest a Grignard Reaction Mechanism of Halogenated SWNTs

Applicants respectfully traverse the Examiner's characterization that *Tour* teaches a reaction of halogenated SWNTs with an alkyl-lithium reagent via a Grignard reaction mechanism. The reference in *Tour* cited by the Examiner (*Tour*; page 2, lines 13 – 18) refers to a reaction of sidewall fluorinated SWNTs with strong nucleophiles, such as alkyl lithium reagents. Further teachings regarding the reaction of sidewall fluorinated SWNTs with alkyl lithium reagents may be found in United States Patent 6,827,918, issued December 7, 2004, (hereinafter, *Margrave*), a portion of which was included as Appendix IV of the response filed March 16, 2009 (see pages A12 – A16 of said response). In particular, *Margrave* clearly teaches that the reaction of sidewall fluorinated SWNTs with alkyl lithium reagents is a nucleophilic substitution (for example, see *Margrave*, Abstract, Column 4, lines 1 – 18; Column 14, lines 51 – 66, and Column 17, line 58 through Column 19, line 6).

The cited reaction taught by *Tour* is a nucleophilic substitution reaction, not the Grignard reaction alleged by the Examiner. Applicants respectfully assert that one of ordinary skill in the art would instantly recognize the difference between a nucleophilic substitution reaction

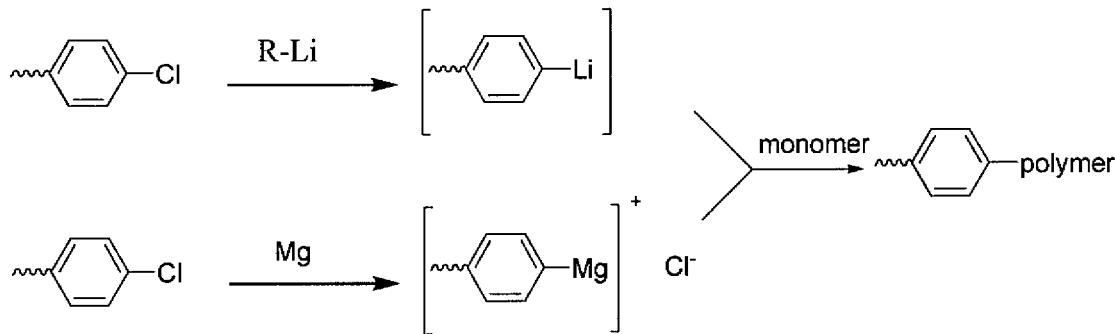
mechanism and a Grignard reaction mechanism. For example, the nucleophilic substitution reaction taught by *Tour* may proceed through the mechanism shown in Figure 1 below.

Figure 1



In contrast to the nucleophilic substitution reaction illustrated in Figure 1 hereinabove, a Grignard reaction (or like halogen-metal exchange reaction) may proceed through the mechanism shown in Figure 2 below. In Figure 2 below, the Grignard reaction (or like halogen-metal exchange reaction) is shown for an aryl halide compound attached to a carbon nanotube, wherein the carbon nanotube portion has been omitted for clarity. As shown in Figure 2, a Grignard reaction (or like halogen-metal exchange reaction) forms an aryl-metal (e.g., Li, Mg or other metal) covalent bond. This behavior contrasts that shown in Figure 1, in which no aryl-metal covalent bond is formed. The aryl-metal bond is operable for initiating a polymerization reaction in which the polymer becomes covalently bound to the carbon nanotubes through the aryl group.

Figure 2



In summary, Applicants respectfully assert that *Tour* does not teach or suggest using a Grignard mechanism or like mechanism with halogenated carbon nanotubes. *Tour* teaches a nucleophilic substitution of sidewall fluorinated SWNTs, which does not involve formation of a formal aryl-metal covalent bond. A Grignard reaction involving formation of a carbon-magnesium bond on the carbon nanotubes is clearly not taught by *Tour*.

Furthermore, Applicants respectfully submit that *Tour* only teaches that sidewall fluorinated SWNTs undergo nucleophilic substitution. In contrast to the allegations of the Examiner, *Tour* does not teach that halogenated SWNTs (i.e., generalized to include chlorine, bromine and iodine) may undergo nucleophilic substitution.

I.3.2 Lamb Does Not Teach or Suggest Initiating a Polymerization with a Grignard Reagent

Applicants also respectfully traverse the Examiner's characterization that *Lamb* teaches a Grignard reaction for initiating a polymerization process. *Lamb* clearly teaches that a Grignard complex mounted on a solid support, not a Grignard reagent, is used to initiate the polymerization process (see *Lamb*, Abstract and Col. 2, lines 1 – 6). *Lamb* teaches that the Grignard complex has a formula RXMg(hal), wherein (hal) is a halogen and X is oxygen, sulfur, selenium or tellurium. *Lamb* expressly teaches that the Grignard complex is formed by the reaction of a Grignard reagent (R'Mg(hal)) with an olefinic oxide or compound containing an unsaturated linkage (see *Lamb*, Column 2, lines 8 – 15). For example, *Lamb* teaches reactions of Grignard reagents with nitriles, nitroso compounds, aldehydes, ketones, esters, inorganic compounds and olefinic oxides to form the Grignard complex (see *Lamb*, column 2, lines 25 –

66). Nowhere is it taught in *Lamb* that a Grignard reagent alone may be used to initiate a polymerization process.

Furthermore, Applicants respectfully assert that the step of forming the Grignard complex of *Lamb* is separate from the step of polymerization. For example, the Examples of *Lamb* set clearly forth deposition of the Grignard complex on a column, followed by polymerization of a monomer in a separate step using the column. As noted above, the Grignard complex is formed by reaction of a Grignard reagent with an olefinic oxide or compound containing an unsaturated linkage. Since *Lamb* clearly teaches that the steps of forming the Grignard complex and polymerizing are separate, it follows that *Lamb* does not teach or suggest initiating a polymerization reaction using a Grignard reagent.

Finally, to the extent that *Lamb* may teach initiating a polymerization process by formation of a Grignard complex, Applicants also respectfully submit that the Grignard complex of *Lamb* does not have a carbon-magnesium bond. As established in the response filed March 16, 2009, Applicants have clearly shown that the Grignard complex of *Lamb* is a simple salt containing a magnesium cation and an anion of an organic addition product. Hence, Applicants respectfully assert that *Lamb* does not teach or suggest a polymerization process in which a carbon-magnesium bond is formed.

I.4 *Independent Claim 2 is Not Obvious*

In the interest of expediting prosecution, Applicants have amended claim 2 to require that the aryl halide functionalized carbon nanotubes comprise a halide selected from the group consisting of chlorine, bromine and iodine. The sidewall fluorinated SWNTs of *Tour* do not suggest aryl chlorides, bromides, and iodides, because aryl fluorides do not typically undergo lithium-halogen exchange to form an aryl-lithium bond. Instead, aryl fluorides are capable of undergoing nucleophilic substitution, as clearly taught by *Tour*.

Applicants respectfully assert that independent claim 2 is not obvious in view of the remarks and amendments presented herein, since *Tour* and *Lamb* fail to teach or suggest all of the claim limitations. As set forth hereinabove, *Tour* teaches a nucleophilic substitution reaction

of sidewall fluorinated SWNTs. This nucleophilic substitution reaction does not form a polymerizable species having aryl-lithium covalent bonds. Likewise, *Lamb* does not teach or suggest a polymerizable species having aryl-lithium covalent bonds, since *Lamb* clearly teaches a polymerization reaction using a **Grignard complex** that does not have an aryl-lithium covalent bond. Furthermore, *Lamb* does not teach or suggest that a Grignard reagent is reactive with an aryl halide selected from aryl chlorides, bromides and iodides. *Lamb* clearly teaches that a polymerization catalyst is formed by reaction of a Grignard reagent with a compound containing an unsaturated linkage or an olefinic oxide. Hence, neither *Tour* nor *Lamb* teach or suggest a polymerizable species having aryl-lithium covalent bonds that is on the carbon nanotube.

Furthermore, Applicants respectfully assert that the **Grignard complex** of *Lamb* is not operable for forming a polymer-carbon nanotube material in which the polymer is covalently bound to the carbon nanotubes. As noted above, *Lamb* does not teach or suggest that a polymerization catalyst can be formed by reaction of a Grignard reagent with aryl chlorides, bromides and iodides. Even to the extent that *Lamb* may teach polymerization through forming a Grignard complex, *Lamb* does not teach or suggest a polymer-carbon nanotube material in which the polymer is covalently bound to the functionalized carbon nanotubes, since *Lamb* does not teach or suggest that the Grignard complex becomes part of the polymer. In contrast, the Grignard complex of *Lamb* merely initiates the polymerization reaction. Even if *Lamb* were to teach means to form a Grignard complex from an aryl halide, Applicants respectfully assert that this Grignard complex would not lead to a polymer becoming covalently bound to the carbon nanotubes. Even if *Lamb* were able to form a Grignard complex on the carbon nanotubes, such a complex would simply form a polymer without said polymer becoming bound to the functionalized carbon nanotube. Hence, the combination of *Tour* and *Lamb* does not teach or suggest a polymer-carbon nanotube material in which the polymer becomes covalently bound to the carbon nanotubes through a polymerization reaction initiated by an aryl-lithium polymerizable species.

In view of the foregoing remarks, Applicants respectfully assert that independent claim 2, as presently amended, is not obvious, since *Tour* and *Lamb* fail to teach or suggest all of the instant claim limitations.

I.5 Independent Claim 3 is Not Obvious

In the interest of expediting prosecution, Applicants have amended claim 3 to require that the aryl halide functionalized carbon nanotubes comprise a halide selected from the group consisting of chlorine, bromine and iodine. The sidewall fluorinated SWNTs of *Tour* do not suggest aryl chlorides, bromides, and iodides, because aryl fluorides do not typically undergo lithium-halogen exchange to form an aryl-lithium bond. Instead, aryl fluorides are capable of undergoing nucleophilic substitution, as clearly taught by *Tour*.

Applicants also respectfully assert that independent claim 3 is not obvious in view of the remarks and amendments presented herein, since *Tour* and *Lamb* fail to teach or suggest all of the instant claim limitations. Applicants' detailed remarks regarding claim 2 hereinabove are incorporated by reference in the discussion that follows to the extent that these comments are also germane to instant independent claim 3. In particular, in view of the foregoing discussion and amendments, Applicants respectfully assert that *Tour* and *Lamb* do not teach or suggest 1) a polymerizable species having aryl-metal covalent bonds that is on the carbon nanotubes or 2) a polymer-carbon nanotube material in which the polymer becomes covalently bound to the carbon nanotubes through a polymerization reaction initiated by an aryl-metal polymerizable species.

In view of the foregoing remarks, Applicants respectfully assert that independent claim 3, as presently amended, is not obvious, since *Tour* and *Lamb* fail to teach or suggest all of the instant claim limitations.

I.6 Independent Claim 10 is Not Obvious

Applicants also respectfully assert that independent claim 10 is not obvious, because *Tour* and *Lamb* fail to teach or suggest all of the instant claim limitations. Applicants' detailed remarks regarding claim 2 hereinabove are incorporated by reference in the discussion that follows to the extent that these comments are also germane to instant independent claim 10. In particular, Applicants respectfully assert that neither *Tour* nor *Lamb* teach or suggest any of 1) nucleation sites/initiator groups, 2) initiating a polymerization reaction using initiator groups, or

3) a polymer-carbon nanotube material in which the polymer becomes covalently bound to the carbon nanotubes through a polymerization reaction initiated by initiator groups.

Tour does not teach or suggest nucleation sites/initiator groups, because the nucleophilic substitution reaction taught by *Tour* does not result in a deprotonation. The nucleophilic substitution reaction of *Tour* is a simple substitution of a fluorine with an alkyl group. Hence, *Tour* does not teach or suggest deprotonation to form an initiator group operable for initiating a polymerization reaction. Nowhere is it taught or suggested in *Tour* that a functional group of any kind may be deprotonated to initiate a polymerization process. Likewise, *Lamb* does not teach or suggest nucleation sites/initiator groups, since formation of the Grignard complexes of *Lamb* does not involve a deprotonation step. The Grignard complexes of *Lamb* are formed by nucleophilic addition of a Grignard reagent to an olefinic oxide or compound containing an unsaturated linkage. Such nucleophilic addition reactions do not involve a deprotonation step. Hence, *Lamb* also does not teach or suggest deprotonation to form initiator groups.

Since neither *Tour* nor *Lamb* teach or suggest deprotonation, Applicants respectfully submit that it follows that the cited references cannot suggest initiating a polymerization reaction with initiator groups.

Finally, as established hereinabove, *Tour* and *Lamb* also do not teach or suggest a polymer-carbon nanotube material in which the polymer becomes covalently bound to the carbon nanotubes through a polymerization reaction initiated by initiator groups.

In view of the foregoing remarks, Applicants respectfully assert that independent claim 10, as presently amended, is not obvious, since *Tour* and *Lamb* fail to teach or suggest all of the instant claim limitations.

I.7 *Independent Claim 1 is Not Obvious*

In the interest of expediting prosecution, Applicants have amended claim 1 to require that the aryl halide functionalized carbon nanotubes comprise a halide selected from the group consisting of chlorine, bromine and iodine. The sidewall fluorinated SWNTs of *Tour* do not suggest aryl chlorides, bromides, and iodides, because aryl fluorides do not typically undergo

lithium-halogen exchange to form an aryl-lithium bond. Instead, aryl fluorides are capable of undergoing nucleophilic substitution, as clearly taught by *Tour*.

Applicants also respectfully assert that independent claim 1 is not obvious for at least the same reasons that independent claims 2, 3 and 10 are not obvious. In particular, independent claim 1 incorporates all of the limitations of independent claims 2, 3 and 10. Since independent claims 2, 3 and 10 are not obvious, as established hereinabove, it follows that independent claim 1 is not obvious for at least the same reasons.

I.8 Summary

In view of the foregoing remarks, Applicants respectfully assert that claims 1, 2, 3 and 10, as presently amended, are not obvious, since *Tour* and *Lamb* fail to teach or suggest all of the claim limitations. Claims 4 – 6, 8, 9, 11 – 28 and 31 – 34 depend either directly or indirectly from these non-obvious claims and are not obvious for at least the same reasons. *In re Fine*, 837 F.2d 1071, 5 U.S.PQ.2d 1596 (Fed. Cir. 1988). Therefore, Applicants respectfully request that the Examiner's rejections of claims 1 – 28 and 31 – 34 under 35 U.S.C. § 103(a) be withdrawn.

CONCLUSIONS

Claims 1 – 6, 8 – 28 and 31 – 34 remain pending in the application. Applicants respectfully submit that claims 1 – 6, 8 – 28 and 31 – 34, as these claims presently stand amended, are in a condition for allowance based on the remarks presented hereinabove.

If additional fees are due and are not included, the Director is hereby authorized to charge any fees or credit any overpayment to Deposit Account Number 23-2426 of Winstead PC (referencing matter 11321-P068WOUS).

If the Examiner has any questions or comments concerning this paper or the present application in general, the Examiner is invited to call the undersigned at 713-650-2663.

ATTORNEY DOCKET NO.
11321-P068WOUS

PATENT
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Respectfully submitted,

WINSTEAD PC

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